PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-289086
(43)Date of publication of application : 04.10.2002

(51)Int.Cl. H01J 1/304
H01J 9/02
H01J 29/04
H01J 31/12

(21)Application number : 2001-089373
(22)Date of filing : 27.03.2001

(71)Applicant : CANON INC
(72)Inventor : KITAMURA SHIN
TSUKAMOTO TAKEO

(54) ELECTRON EMITTING ELEMENT, ELECTRON SOURCE, IMAGE FORMING DEVICE AND MANUFACTURING METHOD FOR ELECTRON EMITTING ELEMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an electron emitting element having high current density, a long life and a simple manufacturing method such that emission points per unit area are increased by regulating the density of carbon fibers.
SOLUTION: An electron emitting element has a first electrode 3 on a substrate 1, a second electrode 2 applying higher electric potential to the first electrode 3, and a plurality of projections 8 on the first electrode 3. In the electron emitting element, the plurality of projections 8 formed on the first electrode 3 are respectively grown from a lump 6 as a core arranged on the first electrode 3 at an interval each other.

LEGAL STATUS
[Date of request for examination]

[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The second electrode which is arranged near the first electrode and this first electrode on a substrate, and impresses high potential to this first electrode on, The electron emission component characterized by growing up considering each of two or more lumps which each of two or more projections which are the electron emission components which have two or more projections, and were formed on said first electrode on said first electrode kept spacing mutually on said 1st electrode, and have been stationed as a nucleus.
[Claim 2] Said projection is an electron emission component according to claim 1 characterized by being the high projection of the aspect ratio which used carbon as the principal component.
[Claim 3] Said projection is an electron emission component according to claim 1 or 2 characterized by being chosen from diamond[a carbon fiber, a carbon nanotube, a graphite fiber, an amorphous carbon fiber, and]-like carbon, a diamond, and a diamond fiber at least.
[Claim 4] Said lump is an electron emission component according to claim 1 to 3 characterized by being the conductive ingredient which has the catalyst function which promotes growth of a carbon fiber.
[Claim 5] Said conductive ingredient is an electron emission component

according to claim 4 characterized by being a metal.
[Claim 6] Said lump is an electron emission component according to claim 1 to 5 characterized by using as a principal component carbon and the ingredient chosen from Fe, nickel, Co, Rh, Pd, and Pt.
[Claim 7] The electron source characterized by being the electron source which comes to connect two or more electron emission components, and this electron emission component being an electron emission component according to claim 1 to 6.
[Claim 8] Image formation equipment characterized by having an electron source according to claim 7 and the image formation member which forms an image with the electron emitted from this electron source.
[Claim 9] The first and the second electrode, and two or more projections that use as a principal component the carbon arranged on this first electrode, The process which is the manufacture approach of an electron emission component of ****(ing), and forms the first and the second electrode, The manufacture approach of the electron emission component characterized by having the process which forms the film containing the ingredient which makes growth of carbon promote on said first electrode, the process which divides said film into two or more fields, and the process into which the projection which uses carbon as a principal component from said divided field is grown up.
[Claim 10] The manufacture approach of the electron emission component according to claim 9 characterized by including the process to which the process which divides said film into two or more fields puts two or more particles in order, and etches said film by using this particle as a mask on said film.
[Claim 11] The manufacture approach of the electron emission component according to claim 10 characterized by being arranged so that said particle may contact mutually.
[Claim 12] The manufacture approach of an electron emission component according to claim 10 or 11 that said particle is characterized by using a silica as a principal component.
[Claim 13] The manufacture approach of the electron emission component according to claim 10 to 12 characterized by the process which etches said film being a process which etches said particle into coincidence and removes it by using said particle as a mask.
[Claim 14] It is the manufacture approach of an electron emission component to a publication in claim 9 characterized by having further the process which arranges the layer which controls etching between said film and said 1st electrode thru/or either of 13.
[Claim 15] The manufacture approach of the electron emission component

according to claim 9 to 14 characterized by including the process which the process which forms the projection which uses said carbon as a principal component forms by vapor growth by using carbon compound gas as a raw material.
[Claim 16] The manufacture approach of an electron emission component according to claim 9 to 15 that the projection which uses said carbon as a principal component is characterized by consisting of diamond[a carbon fiber, a carbon nanotube, a graphite fiber, an amorphous carbon fiber, and]-like carbon, a diamond, or a diamond fiber.
[Claim 17] The process which is the manufacture approach of an electron emission component of having two or more fibers which use as a principal component the carbon arranged so that it may connect with the conductive film arranged on a substrate, and this conductive film electrically, and forms the conductive film on a substrate, The process which forms the layer which has the ingredient which promotes carbonaceous growth on this conductive film, The process which carries out patterning of the layer which has the ingredient which promotes growth of this carbon to a desired configuration, The manufacture approach of the electron emission component characterized by having the process which forms the fiber which uses carbon as a principal component in the layer which has the ingredient which promotes the growth of said carbon in which patterning was carried out to the request configuration by this patterning process.
[Claim 18] The process which is the manufacture approach of an electron emission component of having two or more fibers which use as a principal component the carbon arranged so that it may connect with the conductive film arranged on a substrate, and this conductive film electrically, and forms the conductive film on a substrate, The process which forms the layer which has the ingredient which promotes carbonaceous growth on this conductive film, The process which arranges two or more particles on the layer which has the ingredient which promotes growth of this carbon, and by etching the layer which has the ingredient which promotes growth of this carbon by using this particle as a mask The process which carries out patterning of the layer which has the ingredient which promotes growth of this carbon to a desired configuration, The manufacture approach of the electron emission component characterized by having the process which forms the fiber which uses carbon as a principal component on the layer which has the ingredient which promotes the growth of said carbon by which patterning was carried out to this request configuration.
[Claim 19] Said two or more particles are the manufacture approaches of the electron emission component according to claim 18 characterized by

contacting mutually and being arranged.
[Claim 20] The process which is the manufacture approach of an electron emission component of having two or more fibers which use as a principal component the carbon arranged so that it may connect with the conductive film arranged on a substrate, and this conductive film electrically, and forms the conductive film on a substrate, the manufacture approach of the electron-emission component characterized by to have the process which forms the fiber which uses carbon as a principal component on each of a layer which has the ingredient which promotes growth of plurality, the process which estranges mutually and is formed, and two or more of this carbon for the layer which has the ingredient which promotes carbonaceous growth on this conductive film.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of the electron source which used an electron emission component and this, image formation equipment, and an electron emission component.
[0002]
[Description of the Prior Art] The field emission mold (FE mold) electron emission component to which apply the heavy current community of 106 or more V/cm to a metal, and an electron is made to emit from a surface of metal attracts attention.
[0003] As an example of FE mold electron emission component, "what made the configuration of a cone or a square drill in the substantial verticality direction from the substrate, for example, C. A. Spindt, Physical Properties of thin-film field emissioncathodes with molybdenum cones", and the thing (following Spindt mold) indicated by J. Appl. Phys., 47, 5248 (1976), etc. are known. The mimetic diagram of the Spindt mold electron emission component is shown in drawing 11 . drawing 11 -- setting -- 1 -- for a cathode electrode and 4, as for an emitter and 116, an insulating layer and 115 are [a substrate and 2 / a gate electrode and 3 / an anode plate and 117] the shape of beam. If a forward electrical potential difference is impressed to the gate electrode 2 to an emitter 115, electric-field concentration will take place at the tip

of the radicalized emitter 115, and an electron will be emitted by the principle of operation.
[0004] As other structures, what used carbon fibers, such as a carbon nanotube, for the emitter is indicated by JP,9-221309,A etc. The suitable electropositive potential for a drawer electrode is given, and electron emission is made to perform to a carbon nanotube emitter, as shown in drawing 12 .
[0005] Moreover, the example of the electron source in which the carbon nanotube was formed in pore is indicated by JP,10-12124,A and JP,2000-86216,A. The electron emission component of JP,2000-86216,A is shown in drawing 13 .
[0006]
[Problem(s) to be Solved by the Invention] Image formation equipments, such as a spontaneous light type image display device, are required to obtain high brightness like CRT. Moreover, the fall of driver voltage and increase of the amount of emission electron from a cold cathode emitter are demanded for reduction of power consumption. There is still less amount distribution of currents for every pixel, and the electron emission stabilized for a long time and luminescence of a fluorescent substance are needed.
[0007] In order to continue obtaining quantity brightness for a long time, taking into consideration a fluorescent substance and the life of cold cathode, the cold cathode number per unit area is increased, and the emission current from each cold cathode must be reduced. Moreover, in order to fall driver voltage, radicalized structure like the tip of the Spindt mold must be established so that electric-field concentration may tend to take place.
[0008] It is easy to concentrate electric field with a high aspect ratio, carbon fibers (fiber which uses carbon as a principal component), such as a carbon nanotube, can make electron emission perform by the low battery, and each configuration is detailed, and they can carry out accumulation arrangement per unit area and to high density. Furthermore, it is the ingredient which also has the advantage that it can manufacture cheaply over a large area by vapor growth etc., and was suitable as cold cathode, such as image formation equipment.
[0009] The approach of arranging carbon fibers, such as a carbon nanotube, in the location of a request of a device has the approach of mixing and applying to a paste, after refining the carbon nanotube produced by the arc discharge method and the laser ablation method, and a method of forming a catalyst metal thin film on a substrate, changing into a particle by heat treatment, the exposure of a energy beam, etc.,

and growing up a carbon fiber by using a catalyst particle as a nucleus by supplying and heating material gas.

[0010] In case carbon fibers, such as a carbon nanotube, are manufactured as cold cathode of image formation equipment, a problem generates them here.

[0011] setting moderate spacing and arranging a carbon fiber regularly by the manufacture approach of the conventional carbon fiber, -- difficult -- the consistency of a carbon fiber -- homogeneity -- it was difficult to control highly. It is difficult for the accumulation consistency of a carbon fiber to be high and to apply electric field to each fiber equally with the electron emission component using the carbon fiber produced by the conventional approach. For this reason, increase of the electrical potential difference impressed in order to obtain required current density was caused, and the inclination few consistencies of an electron emission point to be was considering the accumulation consistency of a fiber.

[0012] It is necessary to make the current density per pixel increase, controlling the accumulation consistency of a carbon fiber, considering as structure by which electric field are fully applied to each fiber, increasing an electron emission point, and reducing the amount of emission electron from each fiber, in order to use a carbon fiber more suitably as an electron emission component of image formation equipment.

[0013] The place which it was made in order that this invention might solve the above technical problems, and is made into the purpose controls the consistency of a carbon fiber, and makes the emitting point per unit area increase, and current density is to offer highly the manufacture approach of the electron source which used an electron emission component with the simple production approach, and this for long lasting and a list, image formation equipment, and an electron emission component.

[0014]

[Means for Solving the Problem] Namely, the second electrode which the electron emission component of this invention is arranged near the first electrode and this first electrode on a substrate, and impresses high potential to this first electrode, It is the electron emission component which has two or more projections on said first electrode, and each of two or more projections formed on said first electrode is characterized by growing up considering each of two or more lumps which kept spacing mutually on said 1st electrode, and have been stationed as a nucleus.

[0015] As for said projection, in the electron emission component of this invention, it is desirable that it is the high projection of the

aspect ratio which used carbon as the principal component.
[0016] Moreover, as for said projection, it is desirable to be chosen from diamond[a carbon fiber a carbon nanotube, a graphite fiber, an amorphous carbon fiber, and]-like carbon, a diamond, and a diamond fiber at least.
[0017] Moreover, as for said lump, it is desirable that it is the conductive ingredient which has the catalyst function which promotes growth of a carbon fiber, and, as for said conductive ingredient, it is more desirable that it is a metal.
[0018] Moreover, as for said lump, it is desirable to use as a principal component carbon and the ingredient chosen from Fe, nickel, Co, Rh, Pd, and Pt.
[0019] The electron source of this invention is an electron source which comes to connect two or more electron emission components, and is characterized by this electron emission component being the above-mentioned electron emission component.
[0020] The image formation equipment of this invention is characterized by having the above-mentioned electron source and the image formation member which forms an image with the electron emitted from this electron source.
[0021] Two or more projections which use as a principal component the carbon arranged on the first and the second electrode, and this first electrode the first of the manufacture approach of the electron emission component of this invention, The process which is the manufacture approach of an electron emission component of ****(ing), and forms the first and the second electrode, It is characterized by having the process which forms the film containing the ingredient which makes growth of carbon promote on said first electrode, the process which divides said film into two or more fields, and the process into which the projection which uses carbon as a principal component from said divided field is grown up.
[0022] It is desirable to include the process to which the process which divides said film into two or more fields puts two or more particles in order, and etches said film by using this particle as a mask on said film [in the first place / of the manufacture approach of the electron emission component of this invention], and it is more desirable to be arranged so that said particle may contact mutually.
[0023] Moreover, it is desirable that said particle uses a silica as a principal component.
[0024] Moreover, it is desirable that the process which etches said film by using said particle as a mask is a process which etches said particle

into coincidence and removes it.
[0025] Moreover, it is desirable to have further the process which arranges the layer which controls etching between said film and said 1st electrode.
[0026] Moreover, it is desirable to include the process which the process which forms the projection which uses said carbon as a principal component forms by vapor growth by using carbon compound gas as a raw material.
[0027] Moreover, it is desirable that the projection which uses said carbon as a principal component consists of diamond[a carbon fiber a carbon nanotube, a graphite fiber, an amorphous carbon fiber, and]-like carbon, a diamond, or a diamond fiber.
[0028] The conductive film with which the second of the manufacture approach of the electron emission component of this invention has been arranged on a substrate, The process which is the manufacture approach of an electron emission component of having two or more fibers which use the arranged carbon as a principal component as it connects with this conductive film electrically, and forms the conductive film on a substrate, The process which forms the layer which has the ingredient which promotes carbonaceous growth on this conductive film, The process which carries out patterning of the layer which has the ingredient which promotes growth of this carbon to a desired configuration, It is characterized by having the process which forms the fiber which uses carbon as a principal component in the layer which has the ingredient which promotes the growth of said carbon in which patterning was carried out to the request configuration by this patterning process.
[0029] The conductive film with which the third of the manufacture approach of the electron emission component of this invention has been arranged on a substrate, The process which is the manufacture approach of an electron emission component of having two or more fibers which use the arranged carbon as a principal component as it connects with this conductive film electrically, and forms the conductive film on a substrate, The process which forms the layer which has the ingredient which promotes carbonaceous growth on this conductive film, The process which arranges two or more particles on the layer which has the ingredient which promotes growth of this carbon, and by etching the layer which has the ingredient which promotes growth of this carbon by using this particle as a mask The process which carries out patterning of the layer which has the ingredient which promotes growth of this carbon to a desired configuration, It is characterized by having the process which forms the fiber which uses carbon as a principal component

on the layer which has the ingredient which promotes the growth of said carbon by which patterning was carried out to this request configuration, and, as for said two or more particles, it is desirable to contact mutually and to be arranged.
[0030] The conductive film with which the fourth of the manufacture approach of the electron emission component of this invention has been arranged on a substrate, The process which is the manufacture approach of an electron emission component of having two or more fibers which use the arranged carbon as a principal component as it connects with this conductive film electrically, and forms the conductive film on a substrate, it is characterized by having the process which forms the fiber which uses carbon as a principal component on each of a layer which has the ingredient which promotes growth of plurality, the process which estranges mutually and is formed, and two or more of this carbon for the layer which has the ingredient which promotes carbonaceous growth on this conductive film.
[0031]
[Embodiment of the Invention] With reference to a drawing, an example of the gestalt of suitable operation of this invention is explained in detail in instantiation below. However, the dimension of the component part indicated by the gestalt of this operation, the quality of the material, a configuration, its relative configuration, etc. are not the things of the meaning which limits the range of this invention only to it, as long as there is no specific publication especially.
[0032] First, configuration equalization of a projection of the electron emission component which is the description of this invention, and consistency control processing are explained below.
[0033] In this invention, a carbon nanotube, graphite fiber, amorphous carbon fiber, and diamond fiber is included with "the fiber which uses carbon as a principal component", or a "carbon fiber." As the synthetic approach of the fiber which uses carbon as a principal component, an arc discharge method, a laser evaporation method, a chemical-vapor-deposition method (Following CVD and description), etc. are typical, and there are a heat CVD method and a plasma enhancing CVD method as CVD method further. As a means to carry a carbon fiber in electron devices, such as an electron emission component, as cathode, since selective growth is possible, the CVD method which used the catalyst particle as the nucleus is suitable.
[0034] At the time of the pyrolysis of organic substance (carbon compound) gas, if the catalyst ingredient of the shape of an island with a diameter of about 10-30nm exists on a substrate, the catalyst

ingredient and organic substance will melt together, and, as for the CVD method which used the catalyst particle as the nucleus, a carbon fiber will grow from there. For this reason, if the catalyst particle is arranged in the desired location, it is possible to arrange a carbon fiber alternatively to that field. Therefore, a "catalyst" is an ingredient which promotes carbonaceous (carbon) growth.

[0035] The above-mentioned catalyst ingredient is made into the shape of an island in this invention (it divides). As a concrete example, as shown in drawing 4 , it carries out by etching the catalyst ingredient film by using a particle as a mask.

[0036] drawing 4 -- the pattern of a catalyst ingredient -- homogeneity -- it is the schematic diagram of the process arranged highly, and top view and drawing 4 -b as which drawing 4 -a regarded the front face of these layered products from the mask side is a sectional view. In drawing 4 , the layer (catalyst ingredient layer) in which 3 contains a cathode electrode (cathode electrode) in, and 6 contains a catalyst ingredient, and 5 are mask ingredients, and are a particle in this example.

[0037] If according to this invention two or more particles used as a mask are arranged and the catalyst ingredient concerned is etched on the film containing a catalyst ingredient, the film of the catalyst ingredient corresponding to an early mask core will lump-ize (divided). Furthermore, when it has arranged so that said two or more particles (initial mask) may be contacted, the location (a catalyst ingredient lump's pitch d) of each lumps of a catalyst ingredient is prescribed by the twice of the initial mask radius r, and can control each lumps' (layer containing the divided catalyst ingredient) spacing as d=2r. Furthermore, since it is selectable, the initial mask radius r can set spacing d as arbitration.

[0038] By this approach, after forming the lump of a catalyst ingredient in a desired location, the fiber which uses carbon as a principal component is formed. A carbon fiber grows from the lump of a catalyst ingredient by the pyrolysis of for example, carbon compound gas.

[0039] As carbon compound gas, the steam of organic solvents, such as hydrocarbon gas, such as ethylene, methane, a propane, a propylene, and acetylene, or ethanol, and an acetone, may be used.

[0040] choosing suitably the mask ingredient 5 and the catalyst ingredient layer 6 in these processes -- a carbon fiber -- homogeneity -- it is high and consistency control is attained. In case the catalyst ingredient layer 6 and cathode electrode 3 ingredient etch, when they do not have selectivity, the "etching stop layer" which is a layer for

controlling etching may be put in between the catalyst ingredient layer 6 and the cathode electrode 3. The class of catalyst ingredient is chosen with the kind of the carbon fiber to grow up, and should just combine a suitable mask ingredient and the etching approach according to it.
[0041] An electron emission point can be increased by being able to control the consistency of a carbon fiber by the above processes, and making it electric field built over each fiber according to them. Therefore, reducing the burst size of each fiber, it is possible to increase current density and the life of electron emission material improves. In using as image formation equipment, there is no brightness nonuniformity, degradation of a fluorescent substance is controlled, and it has a uniform display property over a long period of time. Moreover, the process which forms the catalyst ingredient of this invention into a minute lump to homogeneity can be cheaply manufactured over a large area like the usual lithography process.
[0042] Below, an example of the manufacture approach of the electron emission component of this invention is explained.
[0043] An example of the electron emission component configuration from which the manufacture approach of this invention becomes effective is shown in drawing 2 . The top view of the electron emission component which drawing 2 -a requires for the gestalt of this operation, and drawing 2 -b are the A-A' sectional views in drawing 2 -a.
[0044] The "etching stop layer" which is a layer for the catalyst lump (catalyst ingredient layer) with which a cathode electrode (cathode electrode) and 4 had been arranged at the insulating layer, and 6 has been arranged [1 / a substrate and 2] for a cash-drawer electrode (gate electrode) and 3 at desired interval, and 7 to control etching in drawing 2 , and 8 are fibers (carbon fiber) which use carbon as a principal component.
[0045] An example of the manufacture approach of the electron emission component of the gestalt of this operation was shown in drawing 1 . Hereafter, along with drawing 1 , order is explained for an example of the manufacture approach of the electron emission component of the gestalt of this operation later on.
[0046] Beforehand, insulating substrates, such as quartz glass which fully washed the front face, are used as a substrate 1, and the laminating of the cathode electrode 3, the etching stop layer 7, and the layer 6 containing a catalyst ingredient is carried out on a substrate 1 (drawing 1 - a).
[0047] The cathode electrode 3, the etching stop layer 7, and the

catalyst ingredient layer (layer containing a catalyst ingredient) 6 are suitably formed by general vacuum film production techniques, such as vacuum deposition and a spatter, a photolithography technique, etc.

[0048] The cathode electrode 3 has conductivity, for example, is suitably chosen from the metallic compounds of the nitride of carbon, a metal, and a metal, metaled carbide, a metaled boride, a semi-conductor, and a semi-conductor.

[0049] The ingredient of the etching stop layer 7 is chosen with the below-mentioned catalyst ingredient layer 6 and the below-mentioned mask ingredient 5, and may omit the etching stop layer 7. As an ingredient, it is suitably chosen from the metallic compounds of the nitride of carbon, a metal, and a metal, metaled carbide, a metaled boride, a semi-conductor, and a semi-conductor. As thickness of the etching stop layer 7, it is set up in several micrometers from several nm. Moreover, when arranging the etching stop layer 7, in order to take the electrical installation of the catalyst ingredient layer 6 and the cathode electrode 3, it has conductivity.

[0050] The charge of a principal member of the catalyst ingredient layer 6 is suitably chosen from the mixture of at least one or more sorts of metals chosen from nickel, Co, Fe, Cr, Rh, Pt, Pd, Y, La, and Ce, and these metals or carbon, and carbide. And the catalyst ingredient layer 6 has conductivity, in order to take the electrical installation of a carbon fiber 8 and the cathode electrode 3.

[0051] Next, the mask ingredient 5 is formed on the catalyst ingredient layer 6 (drawing 1 - b). The mask ingredient 5 is formed by general vacuum film production techniques, such as a spin coat method, the sprinkling method, and a vacuum deposition method, a spatter, and the photolithography technique.

[0052] When using a particle as a mask ingredient 5, the particle of inorganic substances, such as a particle of the organic substance, such as polymethylmethacrylate (PMMA), a silica, and an alumina, is used. Moreover, the ingredient layer which was formed the organic system resist which carried out patterning with photolithography, and in the shape of an island and which is suitably chosen from the metallic compounds of the nitride of carbon, a metal, and a metal, metaled carbide, a metaled boride, a semi-conductor, and a semi-conductor can be used as a mask. not only consistency control of two or more catalyst lumps 6 but each catalyst lump's 6 spacing -- homogeneity -- in order to control highly, it is suitable to use the spherical particle of organic and an inorganic system. For example, if the water solution of the spherical particle of a silica is applied with a spin coat method, is

calcinated and moisture is removed, the spherical particle of a silica can be arranged in on the catalyst ingredient layer 6. According to this invention person's etc. knowledge, it is possible by adjusting the concentration of the water solution of a silica spherical particle suitably to form the layer which contacted two or more spherical particles mutually.

[0053] The area (in the case of a spherical particle, it is a diameter) of a mask pattern configuration is suitably set up from the range of dozens of micrometers from dozens of nm.

[0054] Next, the process which etches the catalyst ingredient layer 6 is performed by using the mask ingredient 5 as a mask (drawing 1 - c). This etching process is roughly classified into two patterns. 1) When the catalyst ingredient layer 6 is etched with the mask ingredient 5. 2) When the catalyst ingredient layer 6 is alternatively etched to the mask ingredient 5. ******.

[0055] As the etching approach, the wet etching by the etching reagent, the dry etching by etching gas, the chemical dry etching by reactant ion, the physical dry etching by the high energy ion of rectilinear-propagation nature, etc. are used, and it is combination with the mask ingredient 5, the catalyst ingredient layer 6 and the etching stop layer 7, or cathode electrode 3 ingredient, and is chosen suitably.

[0056] If the catalyst ingredient layer 6 is etched according to this process, it will originate in the configuration of the mask ingredient 5, and the island-like catalyst lump (two or more catalyst ingredient layers from which each was separated) 6 will be formed.

[0057] The approach the mask ingredient 5 may remain on the catalyst lump 6 at this etching process (for example, above 2) etc. In that case, the process which removes the mask ingredient 5 by baking and selective etching is added.

[0058] Next, an insulating layer 4 and the drawer electrode (gate electrode) 2 are formed in a part of above-mentioned laminated structure (drawing 1 - d). An insulating layer 4 and the drawer electrode 2 are formed by general vacuum film production techniques, such as vacuum deposition and a spatter, and the photolithography technique.

[0059] As an ingredient of an insulating layer 4, the high ingredient of the pressure-proofing which ceases in high electric field is desirable, and is chosen suitably. As thickness of an insulating layer 4, it is chosen from dozens of nm in dozens of micrometers.

[0060] The ingredient which has conductivity is suitably chosen as the drawer electrode 2. As thickness of the drawer electrode 2, it is set up in several micrometers from several nm. Preferably, the heat-resistant

ingredient of the nitride of carbon, a metal, and a metal and metaled carbide is desirable.
[0061] Next, a carbon fiber 8 is formed for the catalyst lump 6 which has exposed as a nucleus (drawing 1 - e).
[0062] A carbon fiber 8 is formed using growth of the needle crystal using the nuclear growth by CVD, growth of a crystal whisker, etc. The configuration of a carbon fiber 8 is controlled by configuration and ingredient of the class of gas used for a CVD method, the means of gas decomposition, a flow rate, growth temperature, and the catalyst lump 6. Moreover, a configuration may be controlled by applying electric field at the time of CVD.
[0063] in addition, the line which uses as a principal component "the pillar-shaped matter which uses carbon as a principal component", or "carbon with the carbon fiber in this invention -- matter" is contained. Moreover, as an ingredient which constitutes a carbon fiber, carbon compounds, such as carbide, such as TiC, ZrC, HfC, TaC, SiC, and WC, amorphous carbon, graphite, diamond-like carbon, and a diamond, are also included.
[0064] The example of the carbon fiber which decomposes and can do organic substance gas using a catalyst is shown in drawing 5 and 6. In each drawing, the gestalt which is visible to most left-hand side on optical microscope level (- 1000 times), the gestalt which is in sight on scanning electron microscope (SEM) level (- 30,000 times) as for middle, and right-hand side show typically the gestalt of the carbon which appears on transmission electron microscope (TEM) level (- 1 million times).
[0065] As shown in drawing 5 , that to which graphene takes a cylindrical shape-like (that from which cylindrical shape has the multiplet structure is called multi-wall nanotube) gestalt is called a carbon nanotube, and the threshold falls most at the time of the structure where especially the tube tip was made to open wide.
[0066] Or the carbon fiber comparatively generated at low temperature is shown in drawing 6 using a catalyst like a carbon nanotube. The carbon fiber of this gestalt consists of layered products (for this reason, it may be called a graphite nano fiber, but the rate of amorphous structure increases with temperature) of graphene.
[0067] A carbon nanotube and a graphite nano fiber change with the class of catalyst, and temperature of decomposition, with temperature, it may be selectable and only one of structures may be able to do the object which has both structures with the same catalyst.
[0068] The threshold of electron emission is about 1V-10v/micrometer,

and both of the carbon fibers are desirable as an electron emission member of this invention.

[0069] Although Fe, Co, etc. are generally used in formation of a carbon nanotube as a catalyst, also in Pd and nickel, it can use as a nucleus for carbon fiber formation of this invention.

[0070] It is possible to generate a graphite nano fiber at low temperature (temperature of 450 degrees C or more) in Pd and nickel especially. Since the generation temperature of the carbon nanotube using Fe and Co is 800-degree-C or more need, since creation of the graphite nano fiber ingredient using Pd and nickel is possible at low temperature, it is desirable also from the effect of the member on others, and a viewpoint of a manufacturing cost.

[0071] The electron source which allots two or more electron emission components which can apply this invention, and is acquired based on this principle below is explained using drawing 8 . As for an electron source base and 82, in drawing 8 , 81 is [the direction wiring of X and 83] the direction wiring of Y. 84 is the electron emission component of this invention, and 85 is connection.

[0072] the direction wiring 82 of X of m -- DX1, DX2, and .. it consists of DXm and can constitute from a conductive metal formed using a vacuum deposition method, print processes, a spatter, etc. The ingredient of wiring, thickness, and width are designed suitably. The direction wiring 83 of Y is DY1 and DY2.. It consists of wiring of n of DYn, and is formed like the direction wiring 82 of X. The non-illustrated layer insulation layer is prepared between the direction wiring 82 of X of these m, and the direction wiring 83 of Y of n, and both are separated electrically (both m and n are a positive integer).

[0073] A non-illustrated layer insulation layer consists of SiO2 grades formed using a vacuum deposition method, print processes, a spatter, etc. For example, it is formed in the whole surface or some of electron source base 81 in which the direction wiring 82 of X was formed, in a desired configuration, and thickness, an ingredient, and a process are suitably set up so that the potential difference of the intersection of the direction wiring 82 of X and the direction wiring 83 of Y can be borne especially. The direction wiring 82 of X and the direction wiring 83 of Y are pulled out as an external terminal, respectively.

[0074] The electrode (un-illustrating) of the pair which constitutes the electron emission component 84 is electrically connected by the connection 85 which consists of the direction wiring 82 of X of m, direction wiring 83 of Y of n, a conductive metal, etc.

[0075] The ingredient which constitutes the ingredient which constitutes

the direction wiring 82 of X and the direction wiring 83 of Y, the ingredient which constitutes connection 85, and the component electrode of a pair may have same some or all of the configuration element, or may differ, respectively. These ingredients are suitably chosen from the ingredient of the above-mentioned component electrode. When the ingredient and wiring material which constitute a component electrode are the same, wiring linked to a component electrode can also be called component electrode.

[0076] A scan signal impression means by which it does not illustrate [which impresses the scan signal for choosing the line of the electron emission component 84 arranged in the direction of X] is connected to the direction wiring 82 of X. On the other hand, a modulating-signal generating means by which it does not illustrate for modulating each train of the electron emission component 84 arranged in the direction of Y according to an input signal is connected to the direction wiring 83 of Y. The driver voltage impressed to each electron emission component is supplied as a difference electrical potential difference of the scan signal impressed to the component concerned, and a modulating signal.

[0077] In the above-mentioned configuration, using simple matrix wiring, the component according to individual can be chosen and a drive can be made independently possible.

[0078] The image formation equipment constituted using the electron source of such passive-matrix arrangement is explained using drawing 9 . Drawing 9 is the mimetic diagram showing an example of the display panel of image formation equipment, and the electron source base with which 81 allotted two or more electron emission components, the rear plate with which 91 fixed the electron source base 81, and 96 are the face plates with which the fluorescent screen 94 and the metal back 95 grade were formed in the inside of the glass base 93 in drawing 9 . 92 is a housing and the rear plate 91 and the face plate 96 are connected to this housing 92 using frit glass etc. For example, out of atmospheric air, a vacuum, or nitrogen, an envelope 97 is calcinating 10 minutes or more, and is sealed and constituted in the temperature requirement of 400 - 500 degrees.

[0079] An envelope 97 consists of a face plate 96, a housing 92, and a rear plate 91 like ****. Since it is prepared in order to mainly reinforce the reinforcement of the electron source base 81, the rear plate 91 can be made unnecessary [the rear plate 91 of another object] when it has reinforcement sufficient by electron source base 81 the very thing. That is, the direct housing 92 is sealed in the electron source base 81, and an envelope 97 may consist of a face plate 96, a housing 92,

and an electron source base 81. The envelope 97 which has sufficient reinforcement to atmospheric pressure by installing the base material which is not illustrated [which is called a spacer] between a face plate 96 and the rear plate 91 on the other hand can also be constituted.
[0080] The image formation equipment of the gestalt of this operation can be used also as image formation equipment as an optical printer constituted using the photosensitive drum besides indicating equipments, such as an indicating equipment of television broadcasting, a video conference system, and a computer, etc.
[0081]
[Example] Hereafter, the concrete example about the gestalt of this operation is explained to a detail.
[0082] It is drawing 2 about the manufacture approach of the electron emission component of this example to <example 1> drawing 1 . - The top view of the electron emission component produced to a, and drawing 2 - The sectional view was shown in b. Below, the production process of the electron emission component of this example is explained at a detail.
[0083] (Process 1) After using the quartz substrate for the substrate 1 and washing enough, as a cathode electrode 3, Pd with a thickness of 20nm was performed as Ti with a thickness of 5nm and Pt with a thickness of 50nm, and an etching stop layer 7, and it vapor-deposited continuously by the spatter as Ti with a thickness of 10nm and a catalyst ingredient layer 6 (drawing 1 - a).
[0084] (Process 2) next, the layered product whole of a process 1 -- the spherical particle (diameter of 200nm) of a silica -- 5wt(s)% -- the spin coat distributed the included water solution and it dried at 120 degrees C for 20 minutes, and as a mask ingredient 5, the path spherical particle with a diameter of 200nm was put in order so that each particle might touch (drawing 1 - b).
[0085] (Process 3) Next, dry etching of the layered product was carried out by the ion beam etching by Ar gas from on the mask ingredient 5. Since the mask ingredient 5 is a real ball-like, it is deleted from the edge, and the diameter of the mask ingredient 5 decreases with advance of etching. The catalyst ingredient layer 6 on the etching stop layer 7 is etched into massive [independent] with the formation of a form status change of the mask ingredient 5. Etching was advanced until the mask ingredient 5 disappeared completely, and etching was ended in the place where the diameter of the lump 6 which consists of a catalyst ingredient became about about 20nm. Since the etching stop layer 7 was hardly etched, the catalyst lump 6 thickness and whose width of face are about 20nm was formed on the etching stop layer 7 at equal interval. The

distance from a certain catalyst lump's 6 core to the next catalyst lump's 6 core was 200nm (drawing 1 - c).

[0086] (Process 4) Next, the resist pattern was formed on the layered product with photolithography using the negative-mold photoresist (RD2000 / Tokyo adaptation make), Ta with a thickness of 30nm was vapor-deposited as SiO2 with a thickness of 1 micrometer and a cash-drawer electrode 2 as an insulating layer 4 by the spatter from on the, and the hole with a diameter of 2 micrometers was formed by lift off (drawing 1 - d).

[0087] (Process 5) then, the inside of 0.1% ethylene air current which carried out nitrogen dilution -- 500 degrees C and the heat-treatment during 10 minutes -- carrying out -- a hole -- the carbon fiber 8 extended fibrous was formed in the field which the inner catalyst lump 6 has exposed for the diameter of 20nm - about 30nm, being crooked. The thickness of a carbon fiber 8 was set to about 500nm at this time (drawing 1 - e).

[0088] In the vacuum devices 70 of drawing 7 , this component was fully exhausted until it reached 2x10 to 6 Pa with evacuation equipment 71, and the fluorescent substance 72 was installed in the location which is distant from a component H= 2mm as shown in drawing 7 as an anode plate 73. When Va=8kV was impressed as an anode plate (anode) electrical potential difference, it checked that electron emission was not generated by cathode in this condition and the pulse voltage was impressed to the drawer electrode as driver voltage Vf, the current Ie between anode plate-cathode began to be observed from the place like Vf=10V. When luminescence of a fluorescent substance was observed at the time of Vf=20V, there was little luminance distribution in a luminescence field, and luminescence which carried out long duration stability has been checked.

[0089] Forming the catalyst ingredient layer 6 of nickel in the <example 2> process 1, except produced the electron emission component like the example 1 having made the process 3 be the following.

[0090] (Process 3) Wet etching of the layered product was carried out in FeCl3 water solution from on the mask ingredient 5. With advance of etching, the mask ingredient 5 maintains the shape of a real ball before etching, and over etching is carried out to massive [the catalyst ingredient layer 6 under the mask ingredient 5 became independent of]. Etching was ended in the place where the diameter of the lump 6 which consists of a catalyst ingredient became about about 20nm. Then, when the mask ingredient 5 was alternatively removed using buffer fluoric acid, the catalyst lump 6 was formed in homogeneity like the example 1.

[0091] When the electron emission component produced as mentioned above was driven with a configuration like drawing 7 Vf=20V, Ie stabilized like an example 1 was obtained.
[0092] The example of the electron emission component of the horizontal-type structure which separated the gap, pulled out with the component cathode electrode, and formed the electrode on the insulating substrate as a <example 3> example 3 was shown. Hereafter, drawing 3 is met and the manufacture approach of the electron emission component of this example is explained.
[0093] (Process 1) The resist pattern 9 was formed on the quartz substrate 1, and as a cathode electrode 3, Pd with a thickness of 20nm was performed as Ti with a thickness of 5nm and Pt with a thickness of 50nm, and an etching stop layer 7, and it vapor-deposited continuously by the spatter as Ti with a thickness of 20nm and a catalyst ingredient layer 6.
[0094] Then, by the same approach as the process 2 of an example 1, as a mask ingredient 5, the spherical particle (diameter of 200nm) of a silica was put in order so that each particle might touch (drawing 3 - a).
[0095] (Process 2) Next, by the same approach as the process 3 of an example 1, it etched by having used the particle of a silica as the mask, and the catalyst lump 6 was formed on the cathode electrode 3 (drawing 3 - b).
[0096] (Process 3) Next, after exfoliating the early resist pattern 9, Ti with a thickness of 5nm and Pt with a thickness of 50nm were formed as a drawer electrode 2 by photolithography and the spatter. In addition, gap distance (it pulls out with the component cathode electrode 3, and is the distance between electrodes 2) was set to 4 micrometers (drawing 3 - c).
[0097] (Process 4) Then, the carbon fiber 8 was formed by the same approach as the process 5 of an example 1 (drawing 3 - d).
[0098] Ie stabilized when the electron emission component produced as mentioned above was driven with a configuration like drawing 7 Vf=30V was obtained.
[0099] The image formation equipment which allots two or more electron emission components which can apply <example 4> this invention, and is obtained is explained using drawing 8 , and 9 and 10.
[0100] As for an electron source base and 82, in drawing 8 , 81 is [the direction wiring of X and 83] the direction wiring of Y. The electron source to which, as for 84, two or more electron emission components of examples 1 or 2 gathered, and 85 are connection.

[0101] drawing 8 -- setting -- the direction wiring 82 of X of m -- DX1, DX2, and .. it consists of DXm and consists of aluminum system wiring materials with about 1 micrometer [in thickness], and a width of face of 300 micrometers formed with vacuum deposition. The ingredient of wiring, thickness, and width are designed suitably. The direction wiring 83 of Y is the thickness of 0.5 micrometers, width of face of 100 micrometers, and DY1 and DY2.. It consists of wiring of n of DYn, and is formed like the direction wiring 82 of X. The non-illustrated layer insulation layer is prepared between the direction wiring 82 of X of these m, and the direction wiring 83 of Y of n, and both are separated electrically (both m and n are a positive integer).
[0102] The non-illustrated layer insulation layer consisted of SiO(s)2 with a thickness of about 1 micrometer using the spatter etc. It was formed in the whole surface or some of electron source base 81 in which the direction wiring 82 of X was formed, in the desired configuration, and in this example, the thickness of a layer insulation layer was decided that the component capacity per element is set to 1pF or less and component proof-pressure 30V so that the potential difference of the intersection of the direction wiring 82 of X and the direction wiring 83 of Y could be borne especially. The direction wiring 82 of X and the direction wiring 83 of Y are pulled out as an external terminal, respectively.
[0103] The electrode (un-illustrating) of the pair which constitutes the emission component 84 of this invention is electrically connected by the connection 85 which consists of the direction wiring 82 of X of m, direction wiring 83 of Y of n, a conductive metal, etc.
[0104] A scan signal impression means by which it does not illustrate [which impresses the scan signal for choosing the line of the electron emission component 84 of this invention arranged in the direction of X] is connected to the direction wiring 82 of X. On the other hand, a modulating-signal generating means by which it does not illustrate for modulating each train of the electron emission component 84 of this invention arranged in the direction of Y according to an input signal is connected to the direction wiring 83 of Y. The driver voltage impressed to each electron emission component 84 is supplied as a difference electrical potential difference of the scan signal impressed to the component 84 concerned, and a modulating signal. In this example, high potential and the direction wiring 82 of X were connected so that the direction wiring 83 of Y might become low voltage.
[0105] In the above-mentioned configuration, using simple matrix wiring, the component according to individual can be chosen and a drive can be

made independently possible.
[0106] The image formation equipment constituted using the electron source of such passive-matrix arrangement is explained using drawing 9 . This example explains the display panel of the image formation equipment which used soda lime glass as a glass substrate ingredient.
[0107] In drawing 9 , the electron source base with which 81 allotted two or more electron emission components, the rear plate with which 91 fixed the electron source base 81, and 96 are the face plates with which the fluorescent screen 94 and the metal back 95 grade were formed in the inside of the glass base 93. 92 is a housing and the rear plate 91 and the face plate 96 are connected to this housing 92 using frit glass etc. 97 is an envelope, out of a vacuum, is calcinating in the temperature requirement of 450 degrees for 10 minutes, and is sealed and constituted.
[0108] 84 is equivalent to the electron emission section in drawing 9 . 82 and 83 are the direction wiring of X and the direction wiring of Y which were connected with the component electrode of the pair of the electron emission component of this invention.
[0109] An envelope 97 consists of a face plate 96, a housing 92, and a rear plate 91 like ****. The envelope 98 which has sufficient reinforcement to atmospheric pressure by installing the base material which is not illustrated [which is called a spacer] between a face plate 96 and the rear plate 91 on the other hand was constituted.
[0110] The metal back 95 performed data smoothing (usually called "filming".) of the inside side front face of a fluorescent screen 94 after fluorescent screen 94 production, and it was made from making aluminum deposit using vacuum deposition etc. after that.
[0111] In order to raise the conductivity of a fluorescent screen 94 to a face plate 96 further, the transparent electrode (un-illustrating) was prepared in the external surface side of a fluorescent screen 94.
[0112] Drawing 10 is drawing showing the example of a circuit of an image formation panel. drawing 10 -- setting -- 101 -- for a control circuit and 104, as for the Rhine memory and 106, a shift register and 105 are [a display panel and 102 / a scanning circuit and 103 / a synchronizing signal separation circuit and 107] modulating-signal generators.
[0113] A scanning circuit 102 is explained. Inside, this circuit is the thing equipped with M switching elements (S1 thru/or Sm show typically among drawing), and is located. Each switching element chooses the output voltage of direct current voltage supply Vx, or either of 0 [V] (grand level), and is electrically connected with the terminal Dox1 of a display panel 101 thru/or Doxm. Each switching element of S1 thru/or Sm

can operate based on the control signal Tscan which a control circuit 103 outputs, and can be constituted by combining a switching element like FET for example.

[0114] In this example, direct current voltage supply Vx are set up so that a fixed electrical potential difference which the driver voltage impressed to the component which is not scanned based on the property (electron emission threshold electrical potential difference) of the electronic electron emission component of this invention turns into below an electron emission threshold electrical potential difference may be outputted.

[0115] A control circuit 103 has the function to adjust actuation of each part so that a suitable display may be performed based on the picture signal inputted from the exterior. A control circuit 103 generates each control signal of Tscan, Tsft, and Tmry to each part based on the synchronizing signal Tsync sent from the synchronizing signal separation circuit 106.

[0116] The synchronizing signal separation circuit 106 is a circuit for separating a synchronizing signal component and a luminance-signal component from the TV signal of the NTSC system inputted from the outside, and can be constituted using a general frequency-separation (filter) circuit etc. The synchronizing signal separated by the synchronizing signal separation circuit 106 was illustrated as a Tsync signal after [expedient] explaining here, although it consisted of the Vertical Synchronizing signal and the Horizontal Synchronizing signal. The luminance-signal component of the image separated from said TV signal was expressed as the DATA signal for convenience. This DATA signal is inputted into a shift register 104.

[0117] It operates based on the control signal Tsft which a shift register 104 is for carrying out serial/parallel conversion of said DATA signal inputted serially for every line of an image, and is sent from said control circuit 103 (that is, it can also be said that a control signal Tsft is the shift clock of a shift register 104.). The data for the image of one line by which serial/parallel conversion was carried out (equivalent to the drive data for an electron emission component N component) are outputted from said shift register 104 as a parallel signal of Id1 thru/or N individual of Idn.

[0118] The Rhine memory 105 is storage for between need time amount to memorize the data for the image of one line, and memorizes the contents of Id1 thru/or Idn suitably according to the control signal Tmry sent from a control circuit 113. The memorized contents are outputted as I'd1 thru/or I'dn, and are inputted into the modulating-signal generator 107.

[0119] The modulating-signal generator 107 is a source of a signal for carrying out the drive modulation of each of the electronic electron emission component of this invention appropriately according to each of image data I'd1 thru/or I'dn, and the output signal is impressed to the electronic electron emission component of this invention in a display panel 101 through a terminal Doy1 thru/or Doyn.
[0120] As mentioned above, the electron emission component which can apply this invention has the following basic properties to the emission current Ie. That is, there is a clear threshold electrical potential difference Vth in electron emission, and only when the electrical potential difference more than Vth is impressed, electron emission arises. To the electrical potential difference more than an electron emission threshold, the emission current also changes according to change of the applied voltage to a component. When impressing a pulse-like electrical potential difference to this component, for example, even if it impresses the electrical potential difference below an electron emission threshold, electron emission is not produced from this, but an electron beam is outputted when impressing the electrical potential difference beyond an electron emission threshold. It is possible in that case to control the reinforcement of an output electron beam by changing the peak value Vm of a pulse. Moreover, it is possible to control the total amount of the charge of the electron beam outputted by changing the width of face Pw of a pulse.
[0121] Therefore, according to an input signal, an electrical-potential-difference modulation technique, pulse width modulation, etc. are employable as a method which modulates an electron emission component. It faces carrying out an electrical-potential-difference modulation technique, and as a modulating-signal generator 107, the electrical-potential-difference pulse of fixed die length is generated, and the circuit of an electrical-potential-difference modulation technique which modulates the peak value of a pulse suitably according to the data inputted can be used.
[0122] It faces carrying out pulse width modulation and the circuit of pulse width modulation which generates the electrical-potential-difference pulse of fixed peak value as a modulating-signal generator 107, and modulates the width of face of an electrical-potential-difference pulse suitably according to the data inputted can be used.
[0123] The digital signal type was used for a shift register 104 or the Rhine memory 105.
[0124] In this example, an amplifying circuit etc. is added to the modulating-signal generator 107 if needed for example, using a D/A

conversion circuit. In the case of pulse width modulation, the circuit which combined the comparator (comparator) which compares with the output value of said memory the output value of the counter (counter) which carries out counting of the wave number which a high-speed oscillator and an oscillator output, and a counter was used for the modulating-signal generator 107.

[0125] The configuration of the image formation equipment described here is an example of the image formation equipment which can apply this invention, and various deformation is possible for it based on the technical thought of this invention. About an input signal, although NTSC system was held, an input signal is not restricted to this and can also adopt TV signal (for example, high definition TV including MUSE) methods which consist of much scanning lines rather than others and this, such as PAL and an SECAM system.

[0126]

[Effect of the Invention] If the electron emission component explained above according to this invention like is used, an emission current consistency is high and a long lasting electron source can be realized.

[0127] Moreover, in image formation equipment, since it consists of said electron sources and an image is formed based on an input signal, it is realizable, higher definition image formation equipment, for example, color flat television.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing an example of the manufacture approach of the electron emission component by this invention.

[Drawing 2] It is drawing showing an example of the electron emission component by this invention.

[Drawing 3] It is drawing showing other examples of the manufacture approach of the electron emission component by this invention.

[Drawing 4] It is drawing showing an example of the etching process by this invention.

[Drawing 5] It is the schematic diagram showing the structure of a carbon nanotube.

[Drawing 6] It is the schematic diagram showing the structure of a graphite nano fiber.

[Drawing 7] It is drawing showing the example of a configuration when operating the electron emission component by this invention.
[Drawing 8] It is drawing showing the example of a configuration of the passive-matrix circuit using the electron emission component by this invention two or more.
[Drawing 9] It is drawing showing the example of a configuration of the image formation panel using the electron source by this invention.
[Drawing 10] It is drawing showing the example of a circuit of the image formation panel using the electron source by this invention.
[Drawing 11] It is drawing showing the conventional example of an electron emission component.
[Drawing 12] It is drawing showing the conventional example of an electron emission component.
[Drawing 13] It is drawing showing the conventional example of an electron emission component.

[Description of Notations]

1 Substrate
2 Drawer Electrode (Gate Electrode)
3 Cathode Electrode (Cathode Electrode)
4 Insulating Layer
5 Mask Ingredient
6 Catalyst Ingredient Layer (Catalyst Lump)
7 Etching Stop Layer
8 Carbon Fiber
9 Resist Pattern